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ABSTRACT

This exploratory study was conducted to interpret age and individual differences in 48 kindergarteners' and second graders' performance on a referential communication task in light of the Pascual-Leone Theory of Constructive Operations, a neo-Piagetian theory of cognitive development. Stimulus materials were black and white photographs of dogs, cars, and people's faces. The children served as speakers in the communication task and received two forms of feedback from an adult listener: (1) non-specific, verbal feedback of the form "I still don't know which one it is. Is there anything else you can tell me about it?" and (2) if an adequate description was still not given, feedback in the form of specific, visual contrasts. Mental processing capacity and the cognitive style field dependence-independence were assessed in a pretest. Vocabulary repertoires were assessed in a posttest. Age differences in performance on this communcation task appeared to be due to more than just differences in vocabulary and functional adequacy of feature encodings. The mental processing capacity construct proved useful in explaining the older subjects' more consistent application of appropriate executive schemes and minimal interference from affect and field effects. (Author/SB)

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A Neo-Piagetian Analysis of Communication Performance in Young Children

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A Neo-Piagetian Analysis of Communication Performance in Young Children

Abstract

An exploratory study was conducted to interpret age and individual differences in 48 kindergarteners and second graders' performance on a referential communication task in light of a neo-Piagetian theory of cognitive development. The stimulus materials were black and white photographs of dogs, cars, and people's faces. The children served as speakers in the communication task and received two forms of feedback from an adult listener: 1) Non-specific, verbal feedback of the form "I still don't know which one it is. Is there anything else you can tell me about it?" and, if an adequate description was still not given; 2) Specific, visual contrasts. Mental processing capacity and the cognitive style field dependence-independence were assessed in a pretest. Vocabulary repertoires were assessed in a posttest. Age differences in performance on this communication task appeared to be due to more than just differences in vocabulary and functional adequacy of feature encodings. The mental processing capacity construct proved useful in explaining the older subjects' more consistent application of appropriate executive schemes and minimal interference from affect and field effects.

A Neo-Piagetian Analysis of Communication Performance in Young Children

Past research in developmental communication has attributed young children's relatively poor performance to factors of egocentrism (Piaget, 1926; 1967), inability to take the role of the other (Flavell et al., 1968) or to lack of sensitivity to the needs of the listener (cf., Glucksberg et al., 1975). These explanations seem inadequate for several reasons: First of all, performance is not due to an inability; performance reflects some sort of ability. Secondly, these explanations do not account for age and individual differences within young children's performance. And thirdly, definitions of egocentrism and role-taking are circular: you are "egocentric" if you do not "take the role of the other" and you are "unable to take the role of the other" because you are "egocentric." However, recent research (Mueller, 1972; Maratsos, 1973; Garvey and Hogan, 1973; Shatz and Gelman, 1973; and Sachs and Devin, 1976) supports the existence of some role-taking in young children by demonstrating that young children are sometimes sensitive to the needs of their listener.

In order to go beyond the notion of egocentrism to explain instances of young children's sensitivity to the needs of their listener, an exploratory study was conducted to interpret age and individual differences in young primary school children's performance on a referential communication task. (Young primary school children--specifically five year olds and seven year olds--were selected because of the need for language behavior assessment at the K-3 level so that Early Childhood Education curricular goals can be set

and because the changing language environment of this age group makes strong demands on communication skills.) In the referential communication paradigm the speaker and listener are typically separated by an opaque screen and have an identical array of objects in front of them. The goal of the task is for the speaker to describe an object well enough that the listener can recognize the one being described.

The Referential Communication Paradigm

In studies utilizing the referential communication paradigm (Krauss & Glucksberg, 1969; Glucksberg & Krauss, 1967) Krauss and Glucksberg attributed the relatively poor performance of younger subjects in the communication task to a "failure to edit." That is, these younger subjects were not modifying their messages in socially appropriate ways. This notion of "editing" or "comparing" is part of a two-stage stochastic choice process model derived by Rosenberg and Cohen (1966). This model postulates that a speaker samples randomly from his or her repertoire of names for the referent. The names sampled are then compared for applicability to the referent and nonreferents. When the speaker estimates that the name has greater applicability to the referent than nonreferents, there is a high likelihood that it will be emitted. When the sampled name is estimated to be more applicable to the non-referents, the speaker is likely to reject the name and sample a new one. This process continues until a name which meets the comparison criterion is sampled and emitted.

The probelm with the Rosenberg and Cohen model is that it is so idealized that its usefulness in explaining or predicting performance is limited. A more

realistic picture is a network of interacting speaker, listener, stimuli, and feedback variables. The listener, stimuli, and feedback variables were controlled in this study (and will be described in greater detail in the Methods section) so as to focus on characteristics of the speaker. In order to explain the characteristics of a speaker which might affect communication performance, a neo-Piagetian theory of cognitive development was employed.

Neo-Piagetian Theory

The theory, formally known as Pascual-Leone's Theory of Constructive Operators, will not be described here in detail since many descriptions are available elsewhere (Pascual-Leone and Smith, 1969; Pascual-Leone, 1970; Case, 1974; Ammon, 1977). But, basically, there are three central notions: 1) the Piagetian notion of scheme; 2) the notion of a field of activation; and 3) the notion of scheme boosters.

Schemes are the "mental blueprints" (Pascual-Leone, 1974; Note 1) for action which guide our behavior. In addition to the figurative and operative schemes described by Piaget (cf. Inhelder and Piaget, 1969, p. 11), there are executive schemes which are the internal representation of the plans controlling behavior. To a large extent executive schemes determine the activation of particular figurative and operative schemes.

A subset of a subject's repertoire of schemes is his field of activation. The factors which determine whether a scheme is included in a subject's field of activation are known as "scheme boosters." The main scheme boosters, or operators, are: C learning operator, L learning opreator, F-operator, A-operator, and M-operator. C learning, or content learning, accounts for

the modification of individual schemes as a function of experience. L learning, or logical learning, accounts for the rule or structural learning which can be applied beyond situations of specific content. The F-operator is what Piaget refers to as "field effects" and is responsible for the relative weight a subject gives to cues in the perceptual field. The A-operator refers to those situation-bound or situation-free affective factors which can influence the activation weight of perceptual-motor or cognitive schemes.

The M-operator is similar to Piaget's "field of centration" and to notions of mental (or focal) attention and short term (or working) memory. The M-operator is the mental energy available for organizing schemes. Its magnitude is "the maximum number of activated schemes which can be coordinated at any one time" (Case, 1972, p. 287). The important thing about M energy is that its power increases with age, in steps that correspond to each one of Piaget's developmental substages.

Operationalizing Variables According to Neo-Piagetian Constructs

In this investigation M space was measured pre-experimentally in a short term memory task called Mr. Cucui (Diaz, 1974; Case, 1975; Note 2). This task was used to refine the factor grade level by excluding from the kindergarten and second grade samples any subject whose performance fell outside a specified range for the average number of schemes capable of being coordinated at ages 5-6 and 7-8 (cf. Pascual-Leone, 1970). Another pretest procedure--the WISC Block Design (Wechsler, 1958)--was administered to assess the cognitive style field dependence-independence. The WISC Block Design was

chosen because of the strong correlation (r=.76) that Case and Globerson (1974) reported between the WISC Block Design and the Rod and Frame Test, a common measure of field dependence-independence.

In neo-Piagetian theory, the term "cognitive style" refers to general stylistic schemes which determine the F-operator's domination of the executive function (Ammon, 1977). The cognitive style most relevant to describing-recognition tasks such as those based on the referential communication paradigm is that of field dependence-independence. Speakers who are dependent on the perceptual field have a difficult time extracting from a part of the field information which is relevant to the task. Field independent speakers, however, pull relevant information out of the perceptual field with little difficulty. In addition to individual differences in field dependence-independence which cut across levels of M energy, there is a developmental tendency in this cognitive style. That is, with increasing age there is a gradual shift from field dependence to field independence. This shift is related to the developmental increase in M energy. In short, with increasing age a child will have more M energy available for boosting schemes which are independent of the perceptual field.

The neo-Piagetian construct C-learning was operationalized in the post-test measure of vocabulary repertoire. The posttest revealed the extent of a subject's repertoire of values for specific features by posing questions about the referent photographs of the communication task (e.g., "How does the tail look?") A large vocabulary is an obvious advantage to a speaker when describing specific features in a referential communication task. By

assessing vocabulary repertoires post-experimentally these on-demand repertoires could be compared with the spontaneously produced vocabulary displayed in the experiment itself. It is important to distinguish between the speaker who does not have the vocabulary required by the task and the one who has it but for some reason is not utilizing it in the communication task.

The neo-Piagetian construct L-learning was assessed in two ways: First, by noting the frequency with which features were mentioned first or second in a description. (Since many subjects did not produce more than two features, assessment beyond the two-level seemed of minimal benefit); and, secondly, by noting the percentage of relevant features produced in initial descriptions which were previously elicited through negative listener feedback. The rationale for these two assessment procedures concerned speculations about the nature of the rules or structural learning that might facilitate performance in a referential communication task. It would seem that a subject who had some sort of structure for describing stimuli, such as a feature matrix or wholistic image, might be more successful in achieving adequate initial descriptions of a referent than a subject who approached each referent as containing new specific content. Take, for example, the way people talk about real estate. Houses are described as having "X" number of bedrooms, "X" number of bathrooms,and then something about the kitchen, dining room, or yard. Sometimes an unconventional feature like "detached studio" will be mentioned at the end to add an element of uniqueness. Often such wholistic descriptions as "like a Frank Lloyd Wright

house," "a Victorian," or "looks like a hat box" are the most powerful aides to recognition. By noting those features most frequently mentioned first and second in a description, a subject's conventional feature matrix might be revealed. Or, for those subjects who do not bring to the task a conventional feature matrix, perhaps the construction of such a matrix can be observed. One way to assess such "learning" within the task is to count the number of times that features elicited by negative listener feedback are produced spontaneously in subsequent initial descriptions.

The two neo-Piagetian constructs most difficult to operationalize are the A-operator and the executive. The influence of affective involvement with a particular stimulus (e.g., "It looks like my daddy's car") was noted in a subcategory of the variable Functional Categories called Personalized (see Methods for further detail). Assessment of the executive controlling behavior involved two aspects: 1) whether the goal of the task was understood or kept in mind; and 2) what strategies were chosen for attaining that goal. Clues to understanding of the task goal centered around understanding the meaning of "to describe" and understanding what was to be described. Those subjects who clearly did not exhibit an appropriate task goal, such as those who persisted in describing their own car, dog, or friend, were subtracted from the total N for each grade so that percentages of subjects exhibiting appropriate task executives could be obtained. Insight into the executive strategies exhibited for attaining the task goal was gained both by looking at the variable specific features, mentioned earlier in the discussion of L learning, and by noting the extent to which vocabulary

exhibited in the posttest was spontaneously produced in the communication task. In other words, it was hoped that by analyzing the pattern of first- and second-mentioned features and by determining the extent of vocabulary activation, the executive plans controlling a speaker's behavior would begin to appear.

The research questions in this study concerned the interaction between these speaker variables based on neo-Piagetian constructs and such task-related variables as the form of listener feedback, the nature of the stimuli, and the mode of stimulus presentation (see Methods). The research questions had to do with changes in performance within a particular set and across stimulus sets, the effect of negative feedback from the listener, and the influence of speaker characteristics of cognitive style, mental processing capacity, vocabulary repertoire, structures for describing the stimuli, task understanding, and affective involvement.

Method

Subjects

The study involved forty-eight white, middle-class kindergarten and second grade children, half at each grade level and half of each sex. The average age of the kindergarteners during the communication task was 5; 6, while for the second graders it was 7; 7. There were two experimenters: the author served as the listener in the communication task and administered the pre- and posttest; another adult female was present during the communication task to give directions and take note of nonverbal behavior.

Task Description and Procedure

There was approximately a three-week time lapse between administration of the main test and posttest for a subject.

Pretest. - Mental processing space and the cognitive style field dependence-independence were assessed by the pretest measures Cucui test and WISC Block Design respectively. The procedure for administering the WISC Block Design was the same as that described in the Manual for the Wechsler Intelligence Scale for Children (Wechsler, 1958). The Cucui Test (Diaz, 1974) consisted of twenty-six pictures of Mr. Cucui, a potato man. The first six pictures were for practice. In each picture different parts of Mr. Cucui's body were colored. The subject was shown each picture for five seconds and then asked to place on an outline of Mr. Cucui an "X" on the places where Mr. Cucui had been wearing colors. The more spots of colors a subject could remember, the greater the subject's short term memory and, hence, mental processing capacity. The number of colors Mr. Cucui was wearing in test items varied randomly from one to four. There were five items at each of these four levels.

Communication task. - In the main test subjects served as speakers in a referential communication task, where the goal was to describe in isolation a black and white photograph of a dog, car, or person's facial expression well enough that the adult listener could pick out the referent from among an array of nonreferent photographs of the same stimulus set. Other referential communication studies (cf. Glucksberg et al., 1975) have presented referent and nonreferents simultaneously. But a sequential mode of presen-

tation was chosen for this investigation because (1) presentation of the entire non-referent array during a pilot study did not seem to encourage perceptual comparison, whereas sequential presentation of the members of the array did and (2) from a real-world perspective, a listener is more likely to reveal that single item which is closest to the speaker's description than reveal the whole array being considered. The rationale for presenting the referent in isolation instead of in the context of the entire array was also an appeal to ecological validity: In the real world the pool of nonreferents available to a listener is rarely evident to the speaker. Part of the task of a competent speaker is figuring out what features are potentially relevant to the communication.

The stimulus photographs of dogs, cars, and people's faces were chosen because they are part of most every child's world. The photographs were black and white so as to alleviate problems with color labels. (The dog photographs were mounted on 4 1/4" x 5 1/4" tagboard and the faces and cars photographs on 2 1/4" x 3 1/4" tagboard; all photographs were laminated and had neutral backgrounds). Particular care was given to the selection of the referents, making sure that no one-label message would readily suffice to distinguish the referent from the nonreferents. The referent dogs were photographs of mutts and the referent cars were photographs of cars whose make was not easily determined. The referent faces represented "low agreement" emotions, according to the research of Ekman and Friesen (1975). That is, when adults were asked to judge which of seven emotions--<u>happy, sad, fear, anger, surprise, disgust, contempt</u>--were represented in a photograph,

multiple emotions were chosen. (And it should be pointed out that a given array included photographs of different people.) In contrast, the nonreferent faces represented "high agreement" emotions; the nonreferent dogs represented pure breeds; and the nonreferent cars represented standard makes.

The nonreferents were carefully chosen, through pilot testing, with an eye towards their function as visual feedback for inadequate encodings. For example, one of the referent dogs was a big, black dog with a long, curly tail. The nonreferent chosen to emphasize the relevancy of the feature tail was a big black dog with a short, straight tail. Another nonreferent had light colored fur so as to emphasize the feature color. Another nonreferent was chosen because its ears were standing up, in contrast to the referent's, which were hanging down.

Such controlled, visual feedback was seen as very specific and, therefore, extremely powerful in eliciting an adaptive speaker response. But less specific feedback of the form "I still don't know which one it is. Is there anything else you can tell me about it?" was also included because Peterson et al. (1972) had found that instructions of "Look at it again. What else does it look like? Can you tell me something else about it?" enabled four-year-olds to perform as well as seven-year-olds on a referential communication task.

In sum, the communication task consisted of three stimulus sets presented in the six possible permuted orders to groups of subjects who were counter-balanced for grade level and sex. Each stimulus set consisted of six items, the first one being a practice item. The influence of item order was taken into consideration by having two random orders within each stimulus order.

Each item involved four photographs in the referential array, the referent and three nonreferents.

The task instructions were nearly identical for each set of stimulus materials. For example, for dogs the instructions were: "Pretend that you lost your dog and you have to go to the dog pound to see if you can get it back. You must tell the dog catcher what it looks like and she will look at the dogs that are in the pound to see if she can find it." If the speaker's spontaneous initial encoding was not adequate for distinguishing the referent from the nonreferent array, two forms of feedback were provided by the listener: 1) Non-specific verbal feedback of the form "I still don't know which one it is. Is there anything else you can tell me about it?" and, if an adequate description was still not give; 2) Specific, visual contrasts (i.e., nonreferents) that fit the description already provided by the subject but were inconsistent with respect to those relevant features not yet mentioned.

Posttest. - Vocabulary repertoires were assessed in a posttest where the experimenter asked wh-question (e.g., "How do the ears look?") about relevant features of the communication task's referent photographs. All subjects were tested on all features listed in the feature matrices (see Scoring and Treatment of Data) so that the spontaneously produced vocabulary from the communication task could be correlated with that produced on demand in the posttest.

Scoring and Treatment of Data

Pretest. - Scoring procedures for the WISC Block Design were the same as that described in the Manual for the Wechsler Intelligence Scale for

Children (Wechsler, 1958). Subjects' performances were reported as raw scores. Scores for the Cucui test were generated in the following manner: One point was assigned if 4 out of 5 items in a level were "passed;" 1/5 of a point was added for any other item scored perfectly.

Communication task. - Audio-tapes of the communication task were transcribed and scored according to several dependent variables. Consideration was given to the adequacy of the speaker's initial description for distinguishing the referent from the nonreferents, the relevancy of the features mentioned, and the number of steps of listener feedback required before an adequate description was produced. If a speaker's initial description enabled the listener to distinguish the referents from the nonreferents, the description was scored as one adequate initial encoding. For any one subject the potential range of adequate initial encoding within stimulus sets was 0 to 5. If a speaker's initial encoding did not differentiate the referent from the nonreferents, four steps of feedback were available: 1 step of feedback corresponded to non-specific feedback (i.e., "I still don't know which one it is. Is there anything else you can tell me about it?"); 2, 3, and 4 steps of feedback corresponded to specific, visual contrasts. Thus, on any one trial a subject's feedback score could range from 0 to 4. Obviously, if 0 steps of feedback were required, then the subject had an adequate initial encoding.

In addition to the adequacy of an initial encoding, the number of features relevant to the task of distinguishing referent from nonreferents was also scored. The dependent variable for this measure was the number of potentially relevant features mentioned per initial encoding. The word

"potentially" was included because, with the referent presented in isolation, it was felt that the speaker should not be penalized for mentioning a feature which had been relevant in a previous item and, therefore, was potentially relevant in the present item. The scoring criterion for relevant features was determined by a score of 1 for every feature mentioned which was in the relevant feature matrix for each stimulus set. These matrices were developed through extensive pilot testing and contained such conventional features as: hair color/length and shape of eyes and mouth for Faces; color, model, length/shape, and number of doors and windows for Cars; and color, size, orientation, and length/position of ears and tail for Dogs. A feature was considered irrelevant if it was so universal or so personalized as not to help distinguish the referent from the nonreferents (e.g., "This car has tires" or "This dog looks like my dog"). On any one trial the scores for potentially relevant features ranged from 0 on up.

In addition to the quantification of a subject's communication performance, a qualitative analysis of a speaker's performance was conducted by considering (1) the way in which a speaker encoded features prior to feedback and (2) the kinds of responses a speaker made to negative feedback. The dependent variables for the first consideration were: number of qualifiers (Qualifiers), e.g., "a lot," "barely," and "sort of;" the proportion of features in the initial encodings belonging to different categories (Functional Categories), e.g., the universal and personalized examples given above and such negative, wholistic, and part-inferential examples as "It doesn't have a collar," "She looks surprised," and "It has windows like

triangles;" and the frequency with which specific features were mentioned first or second in the initial encoding (Specific Features). The dependent variables for the effect of negative feedback were: the proportion of features in Non-specific and Specific feedback belonging to various categories (e.g., repetitions, expansions, elaborations, and qualifications) and the number of times features elicited through negative feedback were produced spontaneously in subsequent initial encodings within the same stimulus set.

Posttest. - The scoring procedure for relevant features mentioned in the posttest utilized the same relevant feature matrices as were used in the main communication task.

Design

Intercorrelations for the pretest measures Cucui and WISC, the communication task variables adequate initial encodings, potentially relevant features and steps of feedback, and the posttest measure of vocabulary were obtained. Analyses of variance on the communication task and posttest variables were performed with respect to the following factors and their interactions: Grade Level, Sex, Stimulus Set, Stimulus Order, Item Order, Blocks of Trials, and Trials. The factor Stimulus Order took into consideration all possible orderings of the stimulus sets Cars, Dogs, and Faces. The factor Item Order took into consideration the influence of the ordering of the five items, or trials, within a stimulus set by comparing performance on the dependent variables with respect to two randomly selected item orders. The factor Blocks of Trials examined the influence of receiving blocks of five

trials in first position, second position, or third position. In other words, Blocks of Trials examined changes in performance across stimulus sets, whereas Trials examined changes in performance within stimulus sets.

Variables having to do with the initial encoding and response to negative feedback were qualitatively assessed through the use of proportions.

Results

Effects of Grade Level and Task Experience on Performance

Analyses of variance revealed no significant main effect of sex, item order, or stimulus order. Significant Grade Level differences favoring the second grade did, however, appear in the analysis of adequate initial encodings [$F(1,44) = 6.41$, $p < .05$] and potentially relevant features in the posttest [$F(1,44) = 36.51$, $p < .01$]. Significant grade level differences favoring the second grade wre also revealed in analyses of variance on the variables potentially relevant features in the communication task and on steps of feedback. Preliminary ANOVA's on these two variables indicated that the main effect of Grade Level accounted for 16% and 32% of the variance respectively, $F(1,24) = 6.66$, $p < .05$ and $F(1,24) = 16.42$, $p < .01$. Separate analyses were performed for each stimulus set on the variables potentially relevant features in the communication task and steps of feedback when it was discovered that the stimulus set Cars proved to be significantly more difficult than Dogs or Faces for both grades. This difficulty was most clearly revealed in the main effect of stimulus set for the analysis of adequate initial encodings, $F(2,48) = 7.19$, $p < .01$, and is also apparent

when stimulus set means are examined in Table 1. Significant Grade Level differences revealed in these separate ANOVA's favored the second grade in two out of three stimulus sets for steps of feedback [$F(1,24) = 30.83$, $p < .0167$ in Cars] and [$F(1,24) = 8.17$, $p < .0167$ in Dogs] and one out of three stimulus sets for potentially relevant features in the communication task [$F(1,24) = 9.07$, $p < .0167$ in Cars].

Insert Table 1 about here

Examination of the means in Table 1 provides a good context for summarizing grade level differences in the main dependent variables of the communication task. In terms of absolute values of mean grade level performance for potentially relevant features and steps of feedback, presented in Table 1, second graders produced 3.85 relevant features per item and required 1.16 steps of feedback. The kindergarteners produced 2.92 relevant features per item and required 1.8 steps of feedback. The fact that second graders produced on the average about one more relevant feature per item is contrasted with the fact that on the average kindergarteners required nearly two steps of feedback while second graders required about one. In the posttest second graders produced on the average about one more relevant feature per item than the kindergarteners. It should be mentioned that the vast majority of features produced by both grade in the communication task--95% in the second grade and 86% in the kindergarten--were potentially relevant to the task of differentiating referents from nonreferents.

Figure 1 depicts the curves representing the proportion of total items for each grade (e.g., 15 items x 24 subjects, or 360 items) at each step of feedback which were adequately described by the speaker.

Insert Figure 1 about here

Two characteristics of Figure 1 immediately strike the eye: 1) Each grade produced adequate initial encodings less than half the time (44% of the time for the second grade and 25% of the time for the kindergarten[1]); and 2) the shape of the distributions is similar for the two grades. But, it should be noted, the modes for the two distributions are different: the mode for the second grade distribution is 0 steps of feedback, while for the kindergarten it is 2. Neither group provided many adequate descriptions after just 1 step of feedback. This finding is not surprising since one would expect visual feedback (i.e., steps 2, 3, and 4) to be more helpful than feedback of the form "I still don't know which one it is. Is there anything else you can tell me about it?" (i.e., Step 1).

Significant effects of Trials and Blocks of Trials will not be discussed since the significance appeared to be due to differences in stimulus sets rather than to the effect of task experience on performance. It should be mentioned, however, that there was one stimulus set--Faces--in which a significant increase in relevant features was accompanied by a significant decrease in need for feedback. But in this particular stimulus set there was no main effect of Grade Level. Thus, what little learning there was during the course of the communication task had nothing to do with age.

Intercorrelations Within Grade Level

Intercorrelations among the communication task variables adequate initial encodings, potentially relevant features, and steps of feedback, the pretest variables Cucui and WISC, and the posttest variable potentially relevant features in the posttest are presented in Table 2 for the kindergarten and Table 3 for the second grade.

Insert Table 2 and 3 about here

Inspection of Tables 2 and 3 reveals the strength of the intercorrelations among adequate initial encodings, potentially relevant features, and steps of feedback to be strong for the second grade and weak for the kindergarten, except in the case of the correlation between adequate initial encoding and steps of feedback. The high negative correlation for both grades between adequate initial encodings and steps of feedback was to be expected since adequate initial encoding was defined as zero steps of feedback and the fewer adequate initial encodings subjects had, the more steps of feedback they were likely to need.

The correlation of most interest to a discussion of grade level differences in performance on the communication task is the relationship between potentially relevant features and steps of feedback. If kindergarteners' feature encodings were (as a group) qualitatively inferior to those of second graders, then one would expect a lower correlation between feedback and relevant features for kindergarteners. In fact, this was the case.

The hunt for sources of grade level differences in the relationship between feedback and relevant features centered on the manner in which relevant features were encoded and the ability to make use of feedback. With respect to the encoding style variable Specific Features, second graders produced early in their description conventional and relatively permanent characteristics of the stimulus materials, such as number of doors for Cars, fur and length of tail and ears for Dogs, and eye color, hair color and style for Faces. Analysis of Specific Features for kindergarteners revealed a less discriminate use of features in the sense that their features were less conventional and, at times, less permanent. For example, kindergarteners often initiated their descriptions of car referents with such information about tires as color, number, having hubcaps, and the phrase "can drive," or such personalized information as "like my daddy's car." With Dog referents the kindergarteners were most likely to mention first or second in their descriptions the color of the dog's tail or such personalized information as "like my dog." With Faces the features mentioned early in the descriptions were sex, teeth, emotion, color of shirt, and such personalized information as "like my mommy."

The indiscriminate nature of kindergarten feature production was also apparent in the variable Functional Categories. The variable Functional Categories looked at the frequency with which features belonging to various subcategories were produced (see Methods). The subcategories Universals (e.g., "It has tires" for Cars or "It has a nose" for Faces) and Personalized (e.g., "It looks like my daddy's car" or "She looks like my mommy") comprised

the Functional Categories which were not potentially relevant for differentiating referents from nonreferents. Fourteen percent of the kindergarten's features belonged to these two subcategories, while only 5% of the second grade's features fell into these subcategories of irrelevant attributes.

This notion of indiscriminate use of features by the kindergarteners was further supported by the significant and moderately strong correlation between relevant features in the communication task and relevant features in the posttest for the younger subjects, rho = .51, $p < .01$ (see Table 2). As was mentioned earlier, second graders produced, on the average, significantly more relevant features in the posttest than kindergarterners. Yet only for the younger subjects was there a significant, positive correlation between relevant features in the communication task and in the posttest. In a sense, then, kindergarteners were using more of their vocabulary repertoires than second graders. But this relatively large production of relevant features in the communication task did not result in a reduced need for feedback. In general, the observed relationship between relevant features in the main task and posttest seems more consistent with the argument that kindergarten subjects made relatively indiscriminate use of what they had in their repertoires, while second grade subjects were more selective.

With respect to grade level differences in the ability to use feedback, the focus was on transfer of features elicited by negative feedback to spontaneous production in subsequent initial encodings. Such instances of transfer were rare: 8% of the total relevant features produced by kindergarteners and 5% of the total produced by second graders were elicited

through negative feedback and then transferred to subsequent initial encodings. These percentages are so small that the main conclusion to be drawn is that for neither grade was listener feedback providing much of a base for the spontaneously produced relevant features of subsequent initial encodings. But, of course, negative feedback did have an influence on a subject's revision of descriptions for a referent until, finally, an adequate encoding was achieved. In short, negative feedback elicited new responses, whereas positive feedback confirmed old responses. Positive feedback existed in the contrasts the listener selected for Specific feedback. The listener was positively reinforcing the speaker for those relevant features mentioned by choosing contrasts which were consistent on those dimensions. Only in terms of unmentioned relevant features did the listener present contrasts of maximal difference. It would seem, then, that negative feedback, followed by positive feedback, would be most likely to bring about subsequent use. Such a conclusion is difficult to substantiate in this study since no clear parameters existed for positive feedback as they did for the Non-specific and Specific forms of negative feedback.

Significant intercorrelations of communication measures with Cucui were only evident in the second grade and these correlations were only weak to moderate (see Table 3). With the range of Cucui restricted to 1.6 to 2.6 for kindergarteners and 2.8 to 3.6 for second graders, one would not expect very high correlations. But the startling revelation was the direction of the relationships. The negative correlations of Cucui with adequate initial encodings and relevant features and the positive correlation of Cucui with feedback indicate that the higher a second grader's Cucui score the lower

his or her relevant features and adequate initial encodings score and the higher his or her feedback score. Examination of scattergrams revealed the direction of these correlations to be due to a group of four high Cucui/low communication task performers.

The one consistent pattern for both kindergarteners and second graders in the results of the correlation data was the insignificance of the WISC intercorrelations. The lack of significance means that, within grade level, WISC scores were not very predictive of communication performance. But the significance between grade level difference in WISC scores did appear to reflect a cognitive style difference, $t(46) = 8.30$, $p < .01$. As a group the kindergarten found it difficult to overcome the forces inherent in the perceptual field defined by the two-dimensional, black and white nature of the stimuli, particularly in Cars. Hence their field-dependent nature and lower-than-second grade WISC scores. The second graders, being older, had more mental energy available for overcoming misleading field effects. Hence their relatively field-independent nature and relatively high WISC scores.

Discussion

Age differences in performance on this communication task appeared to be due to more than just differences in vocabulary and differences in conventional feature matrices for describing types of stimuli. The posttest assessment of vocabulary repertoires did reveal that on the average second graders had larger vocabulary repertoires than kindergarteners. But in the communication task itself the second graders' spontaneous production of

relevant features was not much larger than the kindergarteners'. The difference between grades in communication performance was that the older subjects were more successful at achieving adequate descriptions during the initial encoding, while the younger subjects more often required two steps of feedback (see Figure 1). But an important point is that the younger subjects, when given feedback of a visual form, were able to produce adequate initial encodings. Furthermore, neither grade exhibited evidence of much learning from the task experience. Thus, whatever it was that enabled the second graders to produce adequate descriptions without the need for negative listener feedback was acquired prior to the task experience.

In exploring what the older subjects had acquired prior to the task experience that enabled them to produce adequate initial encodings, attention was focused on the neo-Piagetian constructs mental processing capacity (M energy) and understanding of the task (the executive). As was explained in the introduction, there were two aspects to a speaker's executive: 1) whether the goal of the task was understood or kept in mind; and 2) what strategies were chosen for attaining that goal. Examination of individual transcripts revealed that appropriate task executives were exhibited by 79% of the second graders and 58% of the kindergarteners.

It appears, therefore, that there were some age differences simply in understanding the nature of the task. But the critical factor in determining the lack of functional adequacy of feature encodings of those kindergarteners who did exhibit an appropriate task goal seems to lie with the choice of specific executive strategies for attaining that goal. The general strategy

for carrying out the task goal of getting the listener to pick the referent out of the nonreferent array would seem to be to say something that would help distinguish the referent from all possible nonreferents in that same stimulus set. Analysis of first and second features emntioned in the variable Specific Features revealed that both grades frequently began their descriptions by mentioning such standard features as color, model, hair color, and emotion. But while the other features mentioned early in second grade encodings tended to be conventional attributes of the stimulus set being described, the other features for the kindergarteners appeared to be primarily a function of perceptual saliency and, secondarily, personal relatedness. These young speakers seemed to be operating under the strategy: Look at the referent and mention anything that might help the listener pick out the referent from the nonreferent array.

Second graders, on the other hand, were able to apply executive strategies which went beyond the common core of conventional features learned prior to the task by both grades to produce less conventional but relatively permanent features (e.g., make and color of lines for Cars; tail length, ear length, fur, and collar for Dogs; and hair style, eye color, and shape of eyebrow and nose for Faces). The strategy that second graders apppeared to be operating under was: Look at the referent and mention conventional and/or permanent features that might help the listener pick out the referent from the nonreferent array. The fact that second graders were more successful at sticking to a conventional feature list was probably due to two factors: 1) Second graders, by virtue of experience, were more likely to have learned a conventional feature list; and 2) Second graders, by virtue

of age, were more likely to have greater M energy for boosting schemes acquired through the learning of specific content and the learning of structures for describing types of stimuli. The M-boosting of alternate structures for describing referents allowed second graders to edit their own descriptions and to switch a wholistic encoding to an analytic one in the midst of initial encodings. For example, when the listener repeated one second grader's initial encoding of "This looks like a gorilla" with a puzzled intonation, the speaker replied, "Because...I don't know. OK, I'll describe it." She then proceeded to analyze the wholistic description "gorilla" into specific features. Second graders' greater amount of M energy might also have been an influence in accounting for the minimal interference of affect and field effects, two factors which played a noticeable role in kindergarten communication behavior.

The maturational construct M energy was not the only source of variance between grades. The second grade's greater reserve of M energy played no part in the significant Trials effect in Faces; for kindergarteners as well as second graders shared in the tendency to produce more relevant features and require less feedback following the first trial. Furthermore, marked individual variation in second grade performance resulted in negative intercorrelations of Cucui with adequate initial encodings and relevant features. Scattergrams of these relationships revealed the negative correlations to be due to a group of above-average Cucui scorers who seemed either to be M-boosting inappropriate executive schemes or failing to overcome the influence of field effects.

The point so clearly portrayed by the performance of this group of second graders is that just because the older subjects have a greater amount of M energy does not mean that they will necessarily use it; or, even if they do use it, they may not necessarily apply it in a task-appropriate way. Thus, age differences appear due to a few subjects who were not necessarily above-average on Cucui scores but who could utilize the M energy they did have available in boosting the learned schemes they had acquired through experience gained in the world.

Reference Notes

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Footnotes

[1]The percentage of adequate initial encodings within each grade ranged from 7% to 53% in the kindergarten and from 0% to 93% in the second grade.

[2]Feedback has the advantage over adequate initial encodings that it has a less restricted range and includes the variable adequate initial encodings as zero steps of feedback.

Table 1

Table of Means for Communication Measures Broken Down

By Grade Level, Stimulus Set, and Blocks of Trials

Dependent Variable	Grade Level							
	Grade K				Grade 2			
Adequate initial encodings								
Cars	.48				2.00			
Dogs	1.44				2.29			
Faces	1.76				2.18			
Mean per 15 trials	3.69				6.48			
Steps of feedback								
Cars	2.18				1.24			
Dogs	1.66				1.07			
Faces	1.57				1.17			
Mean per trial	1.80				1.16			
Relevant features in the main task	1	2	3	T[a]	1	2	3	T[a]
Cars	2.20	2.05	2.32	2.19	2.72	3.70	3.12	3.18
Dogs	3.20	3.97	2.57	3.25	4.47	4.35	3.87	4.23
Faces	2.52	3.40	4.00	3.31	3.62	3.72	5.02	4.12
Mean per trial				2.92				3.85
Relevant features in the posttest								
Cars	2.76				3.79			
Dogs	4.62				5.48			
Faces	4.90				5.81			
Mean per trial	4.09				5.03			

T[a]Represents the average relevant features produced across first, second, and third Blocks of Trials.

Table 2

Spearman Correlation Coefficients for Kindergarteners

(N = 24)

Test	Cucui	WISC	Adequate Initial Encodings	Feedback	Relevant Features	Posttest Relevant Features
Cucui						
WISC	.19					
Adequate Initial Encodings	.10	.09				
Feedback	-.18	-.02	-.82*			
Relevant Features	-.25	-.06	.29	-.34		
Posttest Relevant Features	-.26	-.22	-.16	-.07	.51*	

*p <.01.

Table 3

Spearman Correlation Coefficients for Second Graders

(N = 24)

Test	Cucui	WISC	Adequate Initial Encodings	Feedback	Relevant Features	Posttest Relevant Features
Cucui						
WISC	.16					
Adequate Initial Encodings	-.39*	.00				
Feedback	.37*	-.14	-.96**			
Relevant Features	-.43*	.11	.77**	-.74**		
Posttest Relevant Features	.31	.26	.06	-.06	.26	

*p <.05.

**p <.01.

Figure 1

Distribut on of Steps of Feedback In

Terms of Percentage of Items

Adequately Described